



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Ms. Ellen Gilinsky, Ph.D., Director
Division of Water Quality Programs
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Ms. Gilinsky:

The Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Load (TMDL) for the primary contact use (bacteria) impairment on the North River. The TMDL Report was submitted to EPA for review in January 2006. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Virginia's 1998 Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDL for the primary contact use impairment satisfies each of these requirements.

As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Thomas Henry at (215) 814-5752.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure



Decision Rationale

Total Maximum Daily Load for the Primary Contact Use Impairment on the North River

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint and natural background sources, including a margin of safety (MOS) that may be discharged to a water-quality limited waterbody.

This document will set forth the Environmental Protection Agency's (EPA's) rationale for approving the TMDL for the primary contact (bacteriological) use impairment on the North River. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

- 1) The TMDL is designed to implement applicable water quality standards.
- 2) The TMDL includes a total allowable load as well as individual waste load allocations (WLAs) and load allocations (LAs).
- 3) The TMDL considers the impacts of background pollutant contributions.
- 4) The TMDL considers critical environmental conditions.
- 5) The TMDL considers seasonal environmental variations.
- 6) The TMDL includes a MOS.
- 7) There is reasonable assurance that the TMDL can be met.
- 8) The TMDL has been subject to public participation.

II. Background

The North River Watershed is located in Augusta and Rockingham Counties, Virginia. The North River is a tributary to the South Fork of the Shenandoah River. The bacteriological impairment on the North River is 24.96 miles in length beginning at its confluence with Beaver Creek and extending to its mouth. The 523,300-acre watershed is rural with forested and agricultural lands making up 49 and 48 percent of the watershed respectively. The remainder of the North River Watershed is composed of residential and commercial lands.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed the North River (VAV-B17R) on Virginia's 1998 Section 303(d) list as being unable to attain the primary contact use due to violations of the bacteriological criteria. At

the time of its listing, the state's criteria used fecal coliform as an indicator species and there was an instantaneous standard of 1,000 colony forming units (cfu) per 100 milliliters (ml) and a geometric mean standard of 200 cfu/100 ml. This decision rationale will address the TMDLs for this impairment.

Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA encouraged the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation was drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth adopted the e-coli and enterococci criteria in January 2003. According to the new criteria, streams are evaluated via the e-coli and enterococci criteria after 12 samples have been collected using these indicator species. Twelve e-coli samples have been collected from the North River, and it is therefore, assessed according to the new criteria.

As Virginia designates all of its waters for primary contact, all waters are required to meet the bacteriological standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. The e-coli criteria requires a geometric mean concentration of 126 cfu/100 ml of water with no sample exceeding 235 cfu/100 ml of water. The new e-coli criterion requires the concentration of e-coli not to exceed 235 cfu/100ml of water.

Although the TMDL and criteria require the 235 cfu/100 ml of water concentration limit not be exceeded, waters are not placed on the Section 303(d) list if their violation rate does not exceed 10 percent. Therefore, the North River may be deemed as attaining its primary contact use prior to the implementation of all of the TMDL reductions. It is necessary to keep this in mind because the reductions required to attain the instantaneous criteria for e-coli in the model are extremely stringent.

The bacteriological TMDL submitted by Virginia is designed to determine the acceptable load of e-coli which can be delivered to the impaired segment, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF), in order to ensure that the water quality standard is attained and maintained. HSPF is a dynamic watershed modeling system that simulates both point and non point sources of pollutants, performs flow routing and simulates water quality. HSPF is considered an appropriate model to analyze the impaired water because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions. The model was run to determine the fecal coliform loading to the North River. A translator equation was used to convert fecal coliform results to e-coli.

The bacteriological TMDL analysis allocates the application/deposition of fecal coliform

to land based and instream sources. For land based sources, the model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to the entire complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.¹ Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. Wastes which are deposited directly to the stream do not need a transport mechanism.

Local rainfall and temperature data were needed to develop the model. Weather data provides the rainfall data which drives the TMDL model. Weather data was obtained from the Dale Enterprise, Lynchburg Airport and Elkins Airport weather stations.

Continuous stream flow data was available for the North River from two United States Geological Survey (USGS) gages within the watershed. USGS gage 01620500 was located in the upper watershed around Stokesville and USGS gage 01622000 was located in the middle of the watershed around Burketown. The calibration and validation of the hydrologic model was developed to gage 01622000 since it represented a larger portion of the watershed. The bacteria loading model was calibrated and validated to three VADEQ water quality monitoring stations within the watershed.

Table 1 - Summarizes the Specific Elements of the TMDL.

Segment	Parameter	TMDL	WLA	LA	MOS
North River	E-coli (cfu/yr)	1.98E+14	4.97E+13	1.48E+14	Implicit

The United States Fish and Wildlife Service has been provided with copy of the TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a primary contact (bacteriological) use impairment TMDL for the North River. EPA is therefore approving the TMDL. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources

¹CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks, Virginia.

(both wet weather and directly deposited nonpoint sources) have caused violations of the water quality criteria and designated uses on the North River. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100 ml or an instantaneous standard of no more than 1,000 cfu/100 ml. Two or more samples over a 30-day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a 30-day period, most of the samples were measured against the instantaneous standard.

The Commonwealth has changed its bacteriological criteria as indicated above. The new e-coli criterion requires a geometric mean of 126 cfu/100 ml of water with no sample exceeding 235 cfu/100 ml. The new criterion is more stringent and if the loading remains constant the violation rate should increase.

The HSPF model was used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from direct deposit sources. Once the existing load was determined, allocations were assigned to each source category to develop a loading pattern that would allow the North River to support the e-coli water-quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of e-coli to the North River will ensure that the criterion is attained.

The TMDL modelers determined the fecal coliform production rates within the watershed. Data used in the model was obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc.. The model combined all of the data to determine the hydrology and water-quality of the stream. The lands within the watersheds were categorized into specific land uses. The land uses had specific loading rates and characteristics that were defined by the modelers. Therefore, the loading rates are different in lands defined as forested versus pasture. Pasture lands support cattle and are influenced differently by stormwater runoff.

The North River bacteria TMDL model was run using weather data collected from the Dale Enterprise, Lynchburg Airport and Elkins Airport weather stations. This data was used to determine the precipitation rates in the watershed which transport land deposited pollutants to the stream through overland and groundwater flow. Waste that was deposited to the land or stored was subjected to a die-off rate. The longer fecal coliform stayed on the ground the greater the die-off. Materials that were washed off the surface shortly after deposition were subjected to less die-off. The hydrology model of the TMDL was calibrated to a USGS gage in the watershed. The model was calibrated to observed flow data from September 1, 1985 through

August 31, 1994. During the calibration process, model parameters are adjusted to create a simulated flow record similar to the observed flow record. The calibrated model is then run against a different set of observed flows while all of the flow parameters are held constant. This process is known as validation and the TMDL model was validated to observed flows from September 1, 1990 through December 31, 1994. If the simulated flows of the model resemble the observed flow data of the validation period, the model is assumed to be accurately representing stream hydrology. The model for the North River TMDL simulated the observed

flows in the calibration and validation period well.

The water-quality model for bacteria was calibrated to observed data collected from the North River. The model was calibrated to three water-quality monitoring stations within the watershed, two non-impaired stations in the watershed and an impaired station at river mile 14. There were no violations observed in the upstream stations and the model mirrored these results closely. The observed geometric mean concentration at both upstream stations was 100 cfu/100 ml which represents the lower cap of the data analysis. The simulated geometric mean concentrations for the two stations were 51 and 126 cfu/100 ml. The observed data collected from river mile 14 showed a violation rate of 61 percent with a geometric mean concentration of 541 cfu/100 ml. The model had a simulated violation rate of 60 percent and a geometric mean concentration of 554 cfu/100 ml. The water-quality model represented the observed data collected at the water quality monitoring stations very well.

In the next step of the TMDL, the loadings from all sources were manipulated, increased and decreased to determine which sources have the greatest impact on the model. Then the loads were reduced to develop a scenario which will lead to the attainment of criteria. In order for the North River to attain the applicable criterion, the TMDLs for its upstream tributaries must be met as this represents the majority of the bacteria load to the system. Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the bacteria criteria. Many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions. The North River TMDL does not call for wildlife reductions though previous TMDLs which were developed for its upstream tributaries have called wildlife these reductions.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria and sediment to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There are several permitted dischargers of bacteria to the North River. There are 16 small individual dischargers which are permitted under a general permit and are allowed to

discharge 1,000 gallons of effluent per day with an allowable bacteria concentration at the criterion. There are two sewage treatment plants that hold individual permits and discharge 28,000,000 and 500,000 gallons of effluent per day respectively with an allowable bacteria concentration at the criterion. The last permitted discharger is the Town of Bridgewater's municipal separate storm sewer system (MS-4). The flow from the MS-4 is based on storm runoff which enters the system and is conveyed to the North River. This was also the only point source that needed reductions as the other facilities discharge at criteria. It is expected that best management practices instituted through the MS-4 permit will reduce land based pollutants in the covered area. Table #2 identifies the required load limits under the three non-general permits.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water-quality criterion, a numeric water-quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table #2 – TMDL WLAs for Permitted Dischargers

Facility Name	Permit Number	Flow	Load (cfu/yr)
North River WWTP	VA0060640	28,000,000	4.88E+13
Weyers Cave STP	VA0022349	500,000	8.71E+11
Bridgetown MS-4	VAR040054	N/A	1.22E+10

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings of bacteria, VADEQ used the HSPF model to represent the impaired watersheds. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. HSPF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from

the various land uses within the watershed. Table 3 identifies the current and TMDL loading for bacteria to the North River.

Table 3 - LA for Bacteria (E-coli) for North River

Source Category	Existing Load (cfu/yr)	Allocated Load (cfu/yr)	Percent Reduction
Cropland	2,340E+12	231E+12	90
Built Up	1,752E+12	186E+12	90
Pasture	58,800E+12	5,860E+12	90
Forest	1,380E+12	1,380E+12	0
Livestock - Direct	71E+12	35E+12	50
Wildlife - Direct	86E+12	86E+12	0
Straight Pipes and Sewer Overflows	8E+12	0.0E+00	100

3) The TMDL considers the impacts of background pollution.

The TMDL considers the impact of background pollutants by considering the bacteria loadings from background sources like wildlife and forested lands. The TMDL model was also calibrated to observed data which include background pollutant loads.

4) The TMDL considers critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading and water-quality parameters. The intent of this requirement is to ensure that the water quality of the North River is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards². Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow

(7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The HSPF model was run over a multi-year period to insure that it accounted for a wide

²EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

range of climatic conditions. The allocations developed in the TMDL will therefore insure that the criteria are attained over a wide range of environmental conditions including wet and dry weather conditions.

5) The TMDL considers seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods.

Bacteria loadings also change during the year based on crop cycles, waste application rates, vegetative cover and cattle access patterns. Consistent with the discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and by modifying waste application rates, crop cycles, and livestock practices.

6) The TMDL includes a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the bacteria TMDL through the use of conservative modeling assumptions.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDL has been subject to public participation.

During the development of the TMDL for the North River Watershed, public involvement was encouraged through several meetings to discuss and disseminate the North River TMDL. The first public meeting was held on September 23, 2004 at the John Wayland Elementary School in Bridgewater, Virginia with 19 people in attendance. The second and final

public meeting was held on November 14, 2005 at the same location; 14 people attended the final public meeting. Both public meetings were noticed in the Virginia Register and open to a 30-day public comment period. Two steering committee meetings were held between the public meetings at DEQ's Harrisonburg Office of October 14, 2004 and September 28, 2005. No written comments were received for this TMDL.